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(54) **GAMING DEVICE SECURITY SYSTEM: APPARATUS AND METHOD**

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This patent is subject to a terminal disclaimer.

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(51) **Int. Cl.**[7] **A63F 13/00**

(52) **U.S. Cl.** **463/29**; 463/25; 463/16; 463/42

(58) **Field of Search** 463/16, 20, 25, 463/29, 40–43

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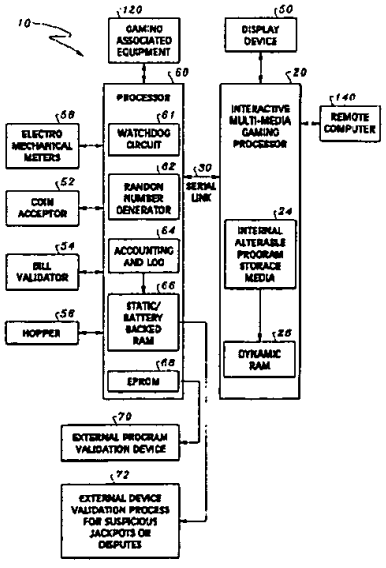
(57) **ABSTRACT**

A gaming device security system is disclosed which includes two processing areas linked together and communicating critical gaming functions via a security protocol wherein each transmitted gaming function includes a specific encrypted signature to be decoded and validated before being processed by either processing area. The two processing areas include a first processing area having a dynamic RAM and an open architecture design which is expandable without interfering or accessing critical gaming functions and a second "secure" processing area having a non-alterable memory for the storage of critical gaming functions therein.

28 Claims, 8 Drawing Sheets



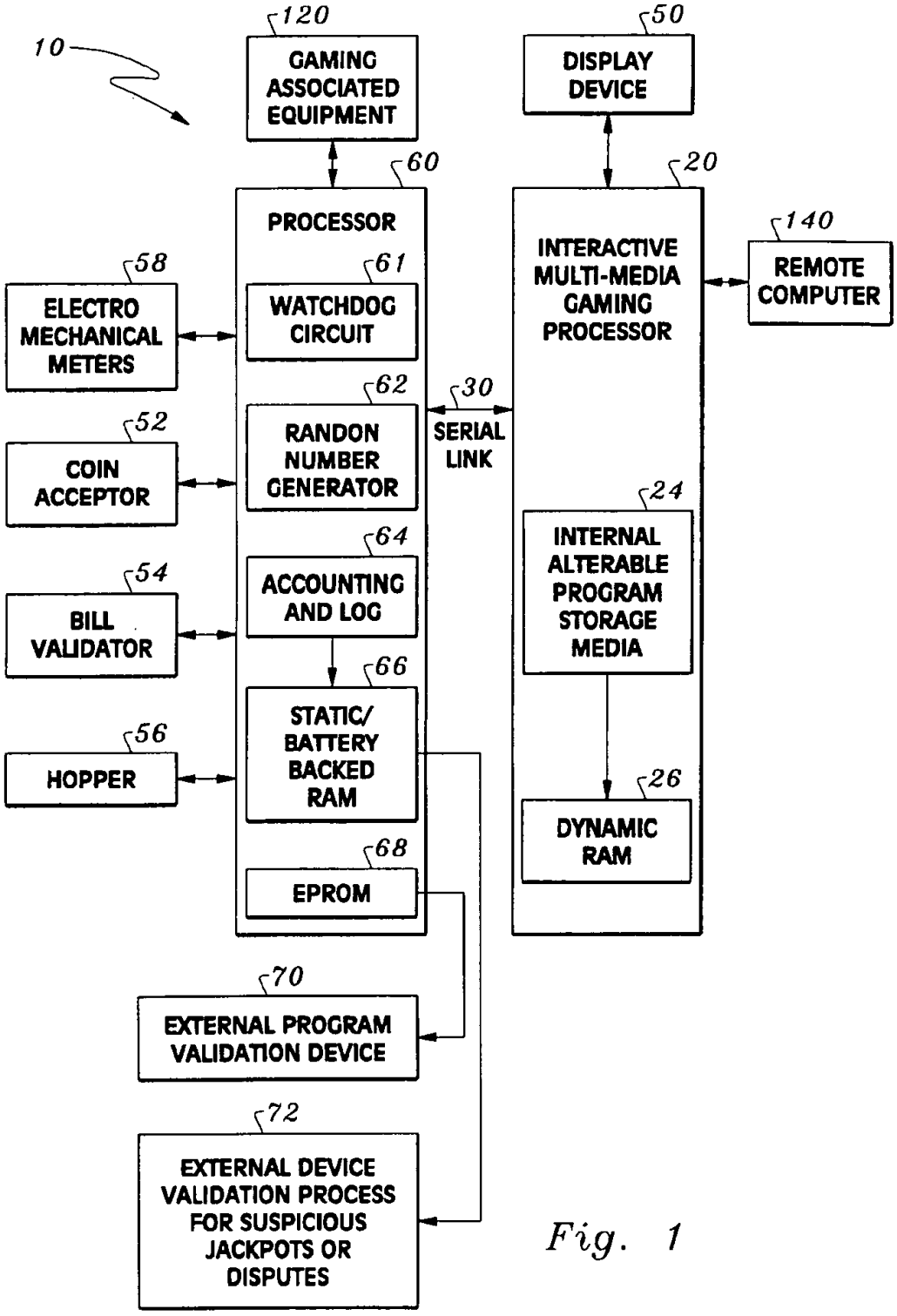

10
120
GAMING ASSOCIATED EQUIPMENT
50
DISPLAY DEVICE
60
PROCESSOR
20
INTERACTIVE MULTI-MEDIA GAMING PROCESSOR
140
REMOTE COMPUTER
58
ELECTRO MECHANICAL METERS
61
WATCHDOG CIRCUIT
62
RANDON NUMBER GENERATOR
30
SERIAL LINK
52
COIN ACCEPTOR
24
INTERNAL ALTERABLE PROGRAM STORAGE MEDIA
64
ACCOUNTING AND LOG
54
BILL VALIDATOR
66
STATIC/ BATTERY BACKED RAM
56
HOPPER
26
DYNAMIC RAM
68
EPROM
70
EXTERNAL PROGRAM VALIDATION DEVICE
72
EXTERNAL DEVICE VALIDATION PROCESS FOR SUSPICIOUS JACKPOTS OR DISPUTES

Fig. 1

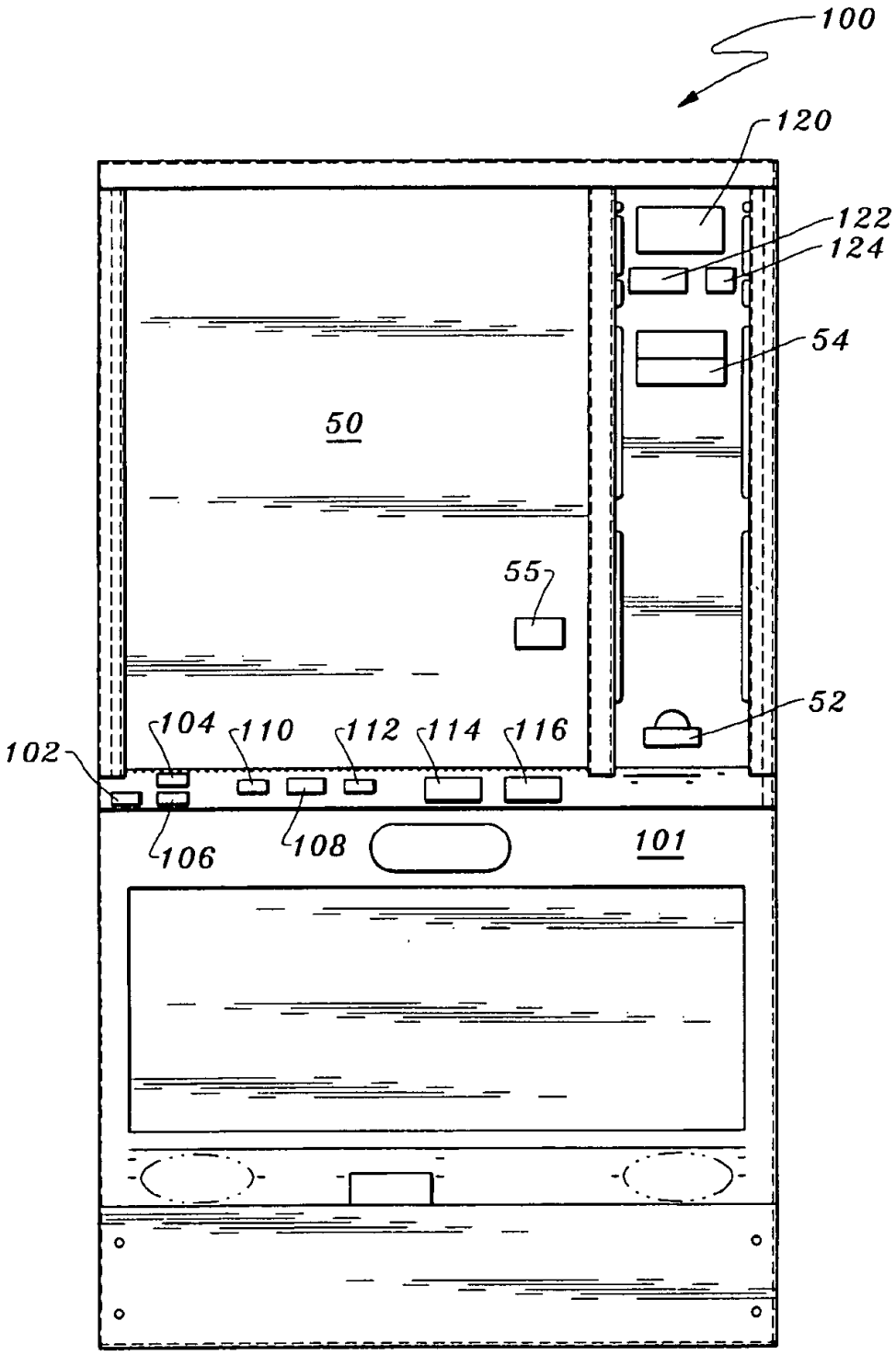


Fig. 2

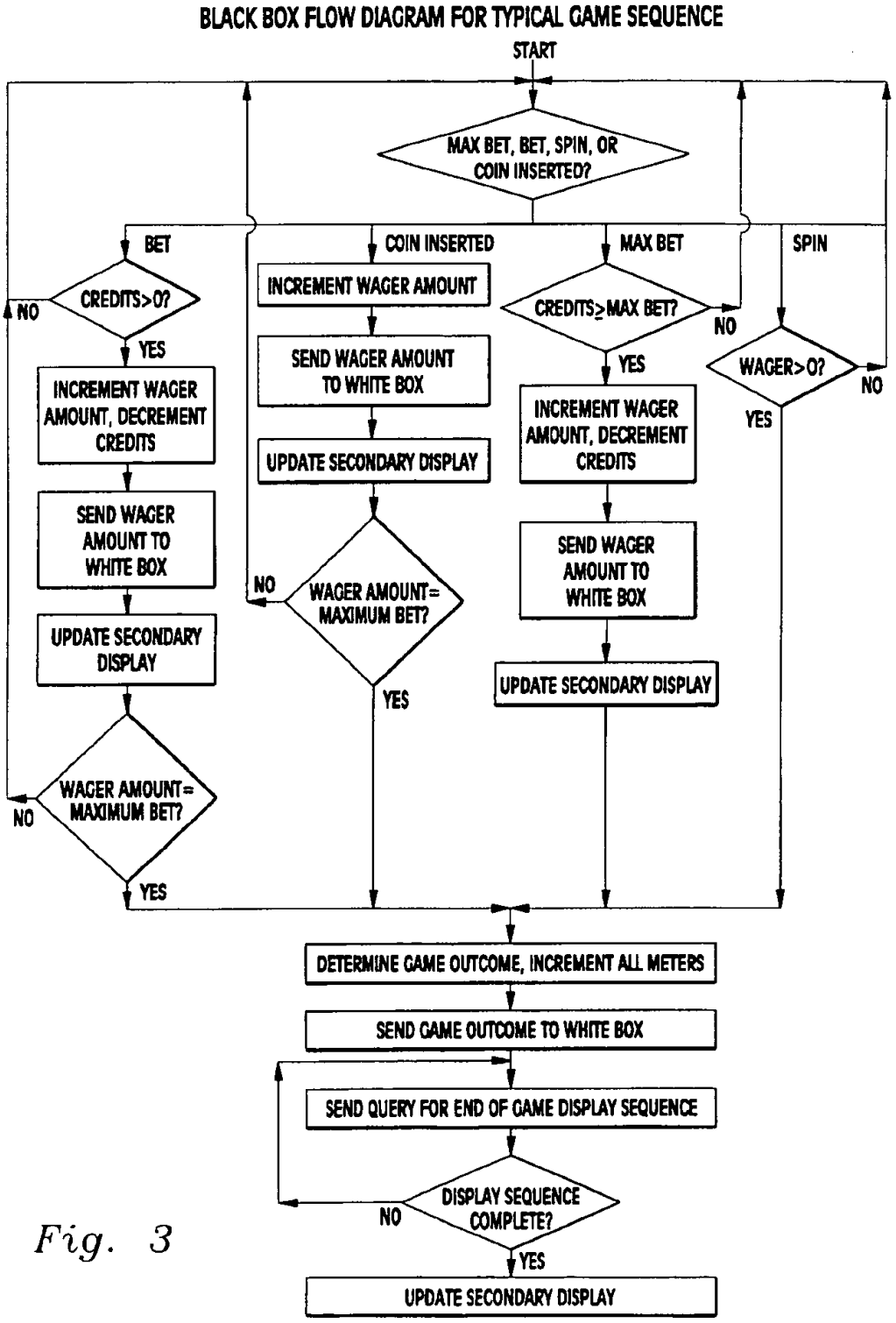

BLACK BOX FLOW DIAGRAM FOR TYPICAL GAME SEQUENCE
START
MAX BET, BET, SPIN, OR COIN INSERTED?
BET
COIN INSERTED
MAX BET
SPIN
CREDITS>0?
NO
YES
INCREMENT WAGER AMOUNT, DECREMENT CREDITS
SEND WAGER AMOUNT TO WHITE BOX
UPDATE SECONDARY DISPLAY
WAGER AMOUNT= MAXIMUM BET?
NO
YES
INCREMENT WAGER AMOUNT
SEND WAGER AMOUNT TO WHITE BOX
UPDATE SECONDARY DISPLAY
WAGER AMOUNT= MAXIMUM BET?
NO
YES
CREDITS≥MAX BET?
NO
YES
INCREMENT WAGER AMOUNT, DECREMENT CREDITS
SEND WAGER AMOUNT TO WHITE BOX
UPDATE SECONDARY DISPLAY
WAGER>0?
NO
YES
DETERMINE GAME OUTCOME, INCREMENT ALL METERS
SEND GAME OUTCOME TO WHITE BOX
SEND QUERY FOR END OF GAME DISPLAY SEQUENCE
DISPLAY SEQUENCE COMPLETE?
NO
YES
UPDATE SECONDARY DISPLAY

Fig. 3

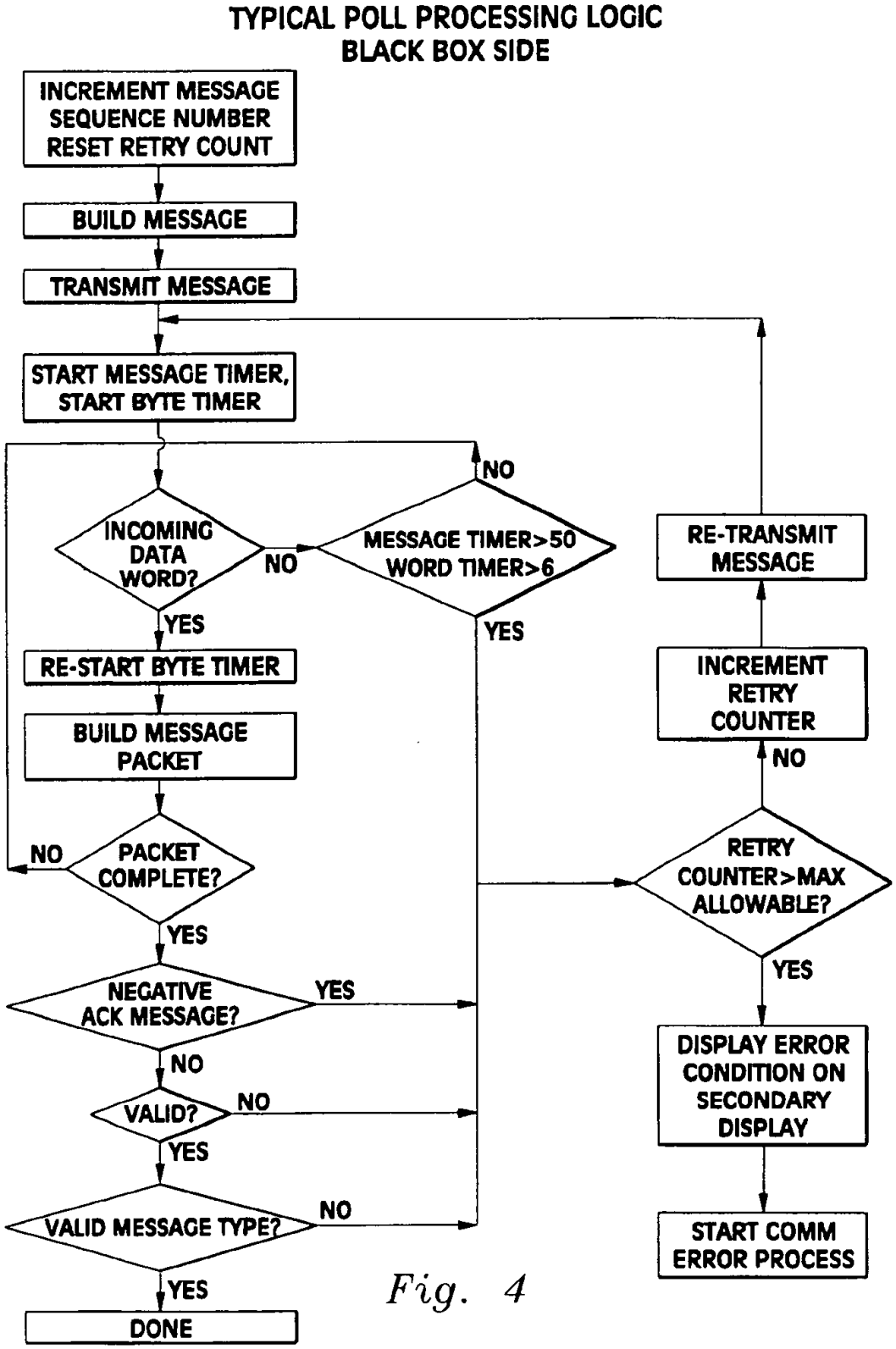

TYPICAL POLL PROCESSING LOGIC
BLACK BOX SIDE
INCREMENT MESSAGE SEQUENCE NUMBER RESET RETRY COUNT
BUILD MESSAGE
TRANSMIT MESSAGE
START MESSAGE TIMER, START BYTE TIMER
INCOMING DATA WORD?
NO
MESSAGE TIMER>50 WORD TIMER>6
NO
YES
YES
RE-START BYTE TIMER
BUILD MESSAGE PACKET
NO
PACKET COMPLETE?
YES
NEGATIVE ACK MESSAGE?
YES
NO
VALID?
NO
YES
VALID MESSAGE TYPE?
NO
YES
DONE
RE-TRANSMIT MESSAGE
INCREMENT RETRY COUNTER
NO
RETRY COUNTER>MAX ALLOWABLE?
YES
DISPLAY ERROR CONDITION ON SECONDARY DISPLAY
START COMM ERROR PROCESS

Fig. 4

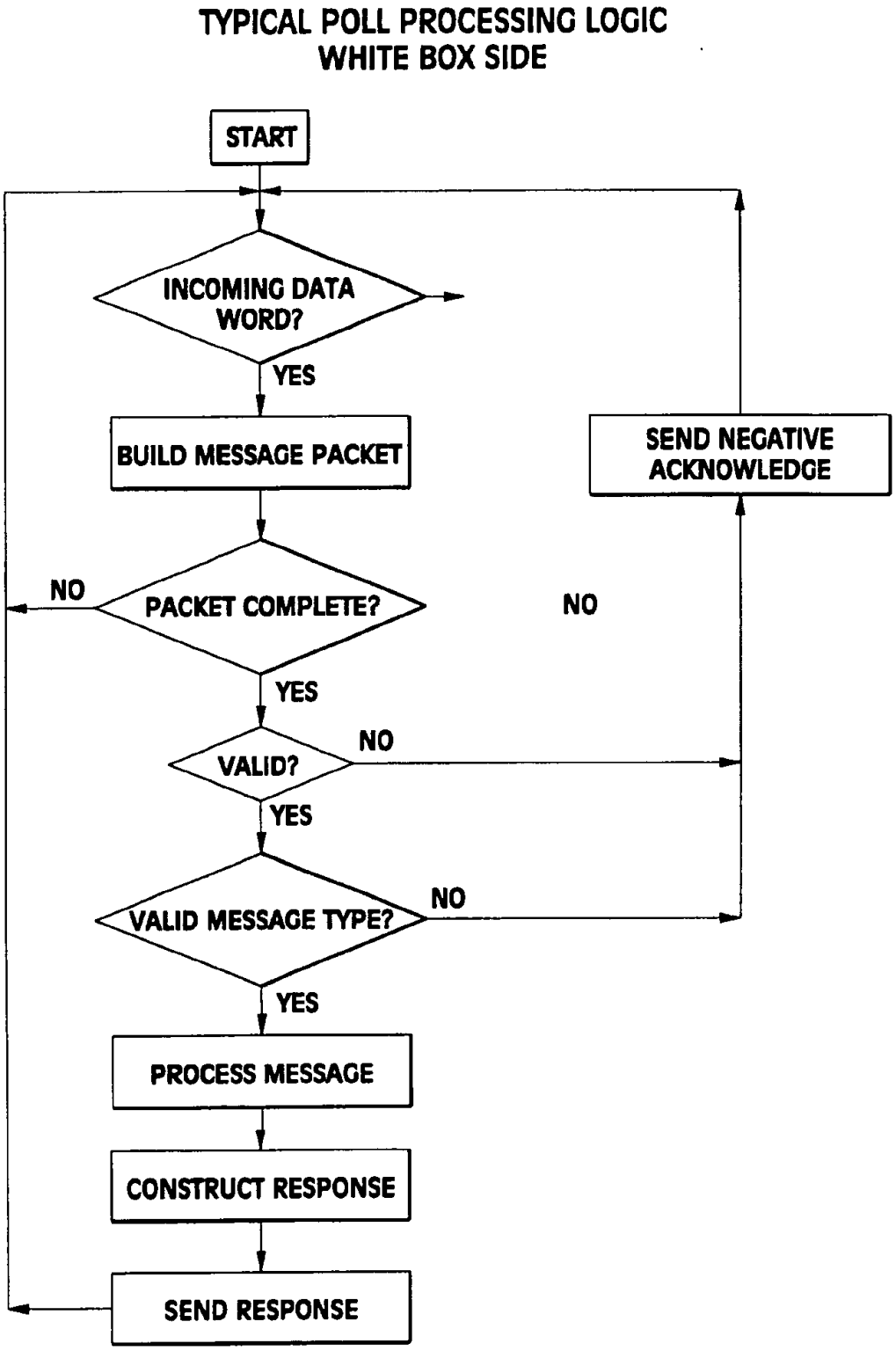

TYPICAL POLL PROCESSING LOGIC
WHITE BOX SIDE
START
INCOMING DATA WORD?
YES
BUILD MESSAGE PACKET
SEND NEGATIVE ACKNOWLEDGE
NO
PACKET COMPLETE?
NO
YES
NO
VALID?
YES
NO
VALID MESSAGE TYPE?
YES
PROCESS MESSAGE
CONSTRUCT RESPONSE
SEND RESPONSE

Fig. 5

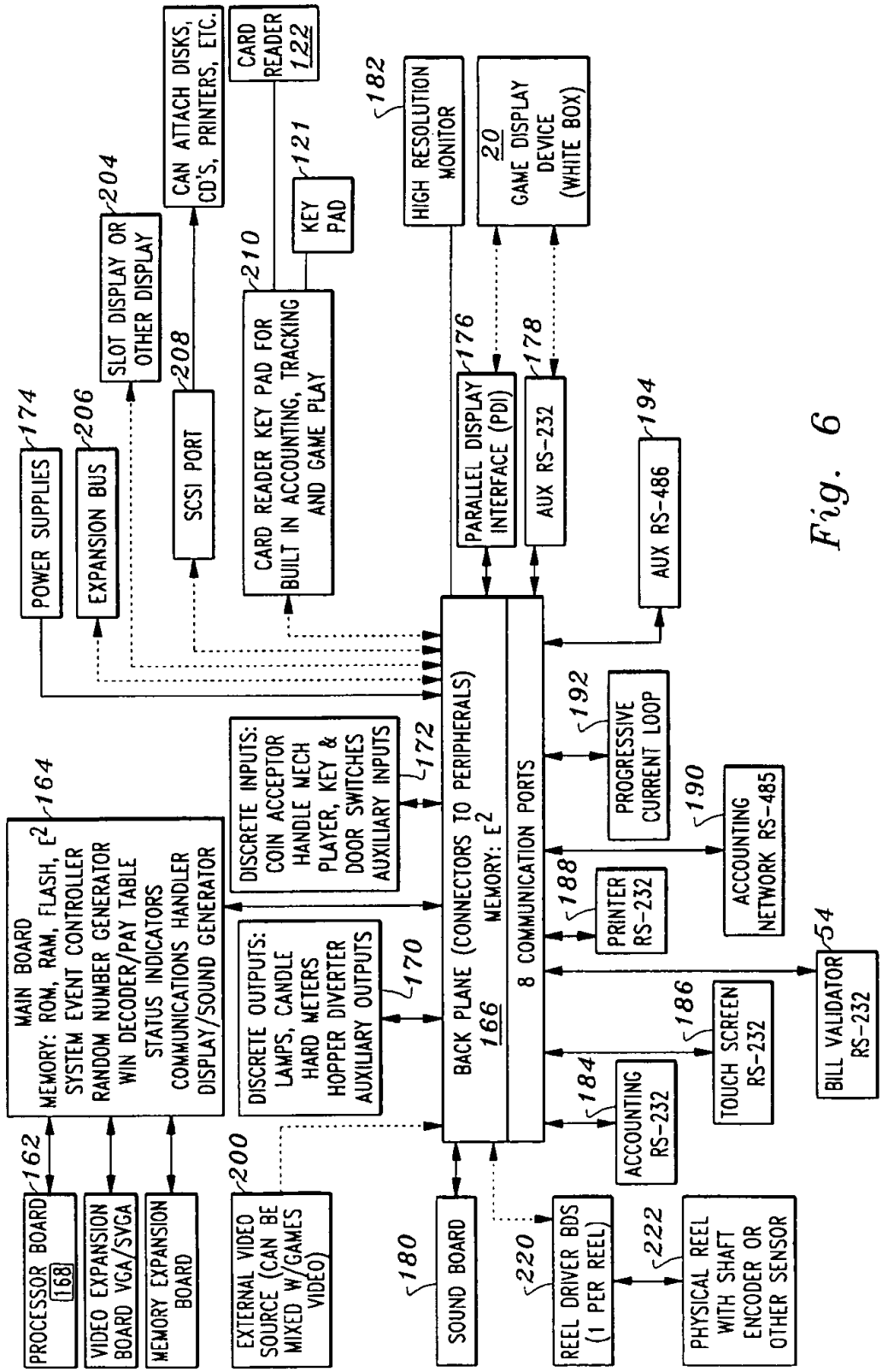

MAIN BOARD
MEMORY: ROM, RAM, FLASH, E2
SYSTEM EVENT CONTROLLER
RANDOM NUMBER GENERATOR
WIN DECODER/PAY TABLE
STATUS INDICATORS
COMMUNICATIONS HANDLER
DISPLAY/SOUND GENERATOR
164
PROCESSOR BOARD
168
162
VIDEO EXPANSION BOARD VGA/SVGA
MEMORY EXPANSION BOARD
EXTERNAL VIDEO SOURCE (CAN BE MIXED W/GAMES VIDEO)
200
DISCRETE OUTPUTS: LAMPS, CANDLE HARD METERS HOPPER DIVERTER AUXILIARY OUTPUTS
170
DISCRETE INPUTS: COIN ACCEPTOR HANDLE MECH PLAYER, KEY & DOOR SWITCHES AUXILIARY INPUTS
172
BACK PLANE (CONNECTORS TO PERIPHERALS)
166
MEMORY: E2
8 COMMUNICATION PORTS
SOUND BOARD
180
REEL DRIVER BDS (1 PER REEL)
220
PHYSICAL REEL WITH SHAFT ENCODER OR OTHER SENSOR
222
ACCOUNTING RS-232
184
TOUCH SCREEN RS-232
186
PRINTER RS-232
188
ACCOUNTING NETWORK RS-485
190
PROGRESSIVE CURRENT LOOP
192
BILL VALIDATOR RS-232
54
AUX RS-486
194
AUX RS-232
178
PARALLEL DISPLAY INTERFACE (PDI)
176
HIGH RESOLUTION MONITOR
182
20
GAME DISPLAY DEVICE (WHITE BOX)
CARD READER KEY PAD FOR BUILT IN ACCOUNTING, TRACKING AND GAME PLAY
210
KEY PAD
121
CARD READER
122
CAN ATTACH DISKS, CD'S, PRINTERS, ETC.
SLOT DISPLAY OR OTHER DISPLAY
204
SCSI PORT
208
EXPANSION BUS
206
POWER SUPPLIES
174

Fig. 6

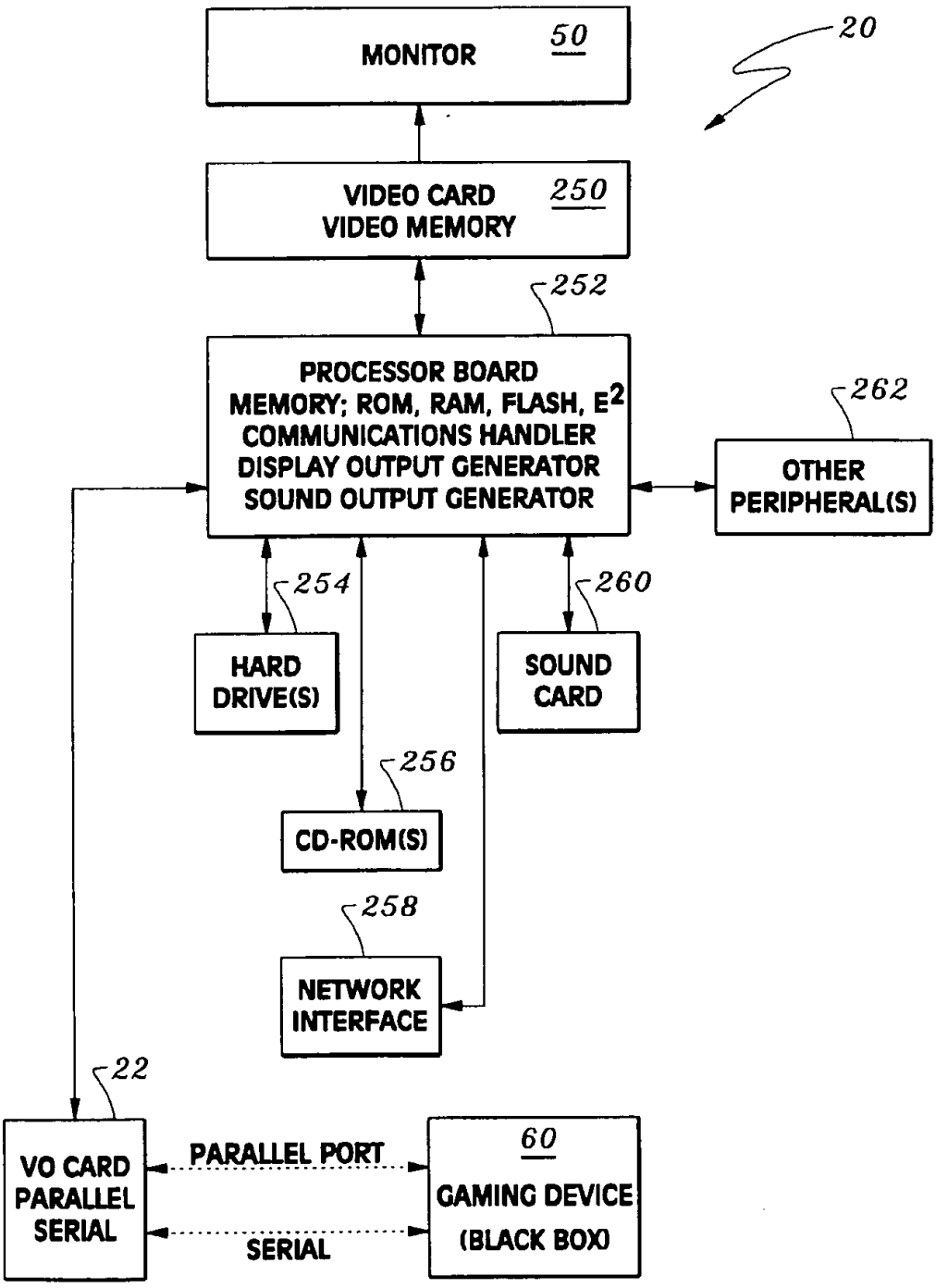

MONITOR
50
20
VIDEO CARD
VIDEO MEMORY
250
252
PROCESSOR BOARD
MEMORY; ROM, RAM, FLASH, E2
COMMUNICATIONS HANDLER
DISPLAY OUTPUT GENERATOR
SOUND OUTPUT GENERATOR
262
OTHER
PERIPHERAL(S)
254
260
HARD
DRIVE(S)
SOUND
CARD
256
CD-ROM(S)
258
NETWORK
INTERFACE
22
VO CARD
PARALLEL
SERIAL
PARALLEL PORT
SERIAL
60
GAMING DEVICE
(BLACK BOX)

Fig. 7

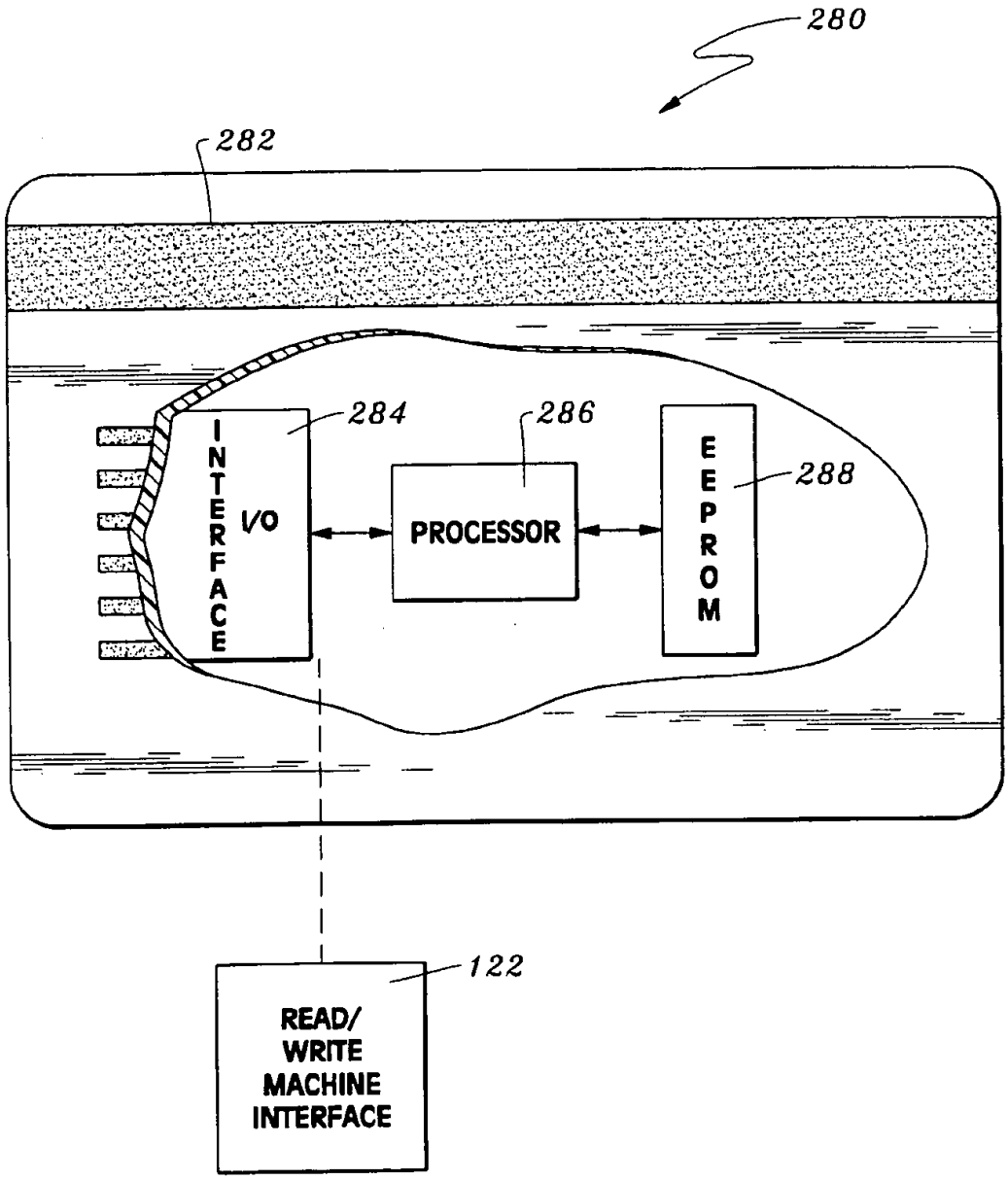

280
282
284
286
288
INTERFACE I/O
PROCESSOR
EEPROM
122
READ/ WRITE MACHINE INTERFACE

Fig. 8

GAMING DEVICE SECURITY SYSTEM: APPARATUS AND METHOD

This application is a continuation of Ser. No. 08/861,092 filed May 21, 1997 now U.S. Pat. No. 6,071,190.

FIELD OF THE INVENTION

The present invention relates generally to gaming devices, and in particular, to an advanced video and slot gaming device security system having dual processing areas with a master/slave relationship wherein the master includes a secure processing area including critical gaming functions stored and executed from a non-alterable media by the secure processing area while allowing the slave processing area to have an open architecture which is expandable without compromising critical gaming functions and retaining the ability for regulatory validation of the secure processing area of the system.

BACKGROUND OF THE INVENTION

Traditional gaming devices are based around a simple processor unit including a random number generator, an accounting means operatively coupled to a static/battery backed random access memory, and an EPROM having stored therein the important gaming functions. In addition, these gaming devices include gaming displays, coin acceptors, bill validators and hoppers operatively coupled to the simple processor. These gaming devices are relatively simple and limited in scope, usually consisting of a single executing program utilizing straight forward interrupt schemes and detection loops for asynchronous events for simple evaluation. It is also a simple matter of operatively coupling an external program validation device to the EPROM for providing effective regulatory validation of critical gaming functions to preclude unauthorized tampering or modification of the gaming machine through software. In addition, an external device validation process for suspicious jackpots or disputes may be validated by simply reading the static/battery backed random access memory associated with the simple processor. Furthermore, software developers in the gaming industry are hesitant to include compromising code in traditional gaming devices due to the ease of both internal and regulatory review.

Currently, most casinos protect their large jackpots by sealing the EPROM devices containing critical code for game functions with serialized tape, and validating the code contents against a standard after a large win.

Today's trend in gaming devices is towards an increasing utilization of personal computer based gaming platforms. Personal computer based platforms are being employed by designers to make use of real time operating systems which allow for multi-threaded/multi-tasking processes and the use of many "off the shelf" device drivers. While at first, this may seem an advantage, it is not a wise choice in an environment requiring high security and regulatory monitoring. Designs of this nature elude validation by regulatory authorities in two areas, initial laboratory evaluation and field validation. Any in depth review of a PC based gaming device is both difficult and far from definitive, requiring tremendous engineering resources and specialist in computer security which are expensive and normally available only on a consultant basis. Even if these resources were available, it is impossible to study the hundreds of thousands of lines of source code comprising all of the elements of such a system. In addition, the time involved in just learning how to build the executable code from the source for

correlation is time and resource prohibited. The multi-threaded/multi-tasking process nature of the programs in these devices make it extremely difficult to locate any compromising code which becomes clandestine since the actual sequence of the execution is hidden to the evaluating engineer. Furthermore, the code set for a complex PC device may not be fully embraced by the evaluating engineer.

The significant reduction of risk for detection in compromising the more complex code is an invitation to inside compromise by device designers. Further, PC based devices are simply not field verifiable, rendering any gaming jurisdiction's device inspection program or any other field validation effort useless for this gaming equipment. For example, the device must be essentially disassembled so that all BIOS EPROMs and any other software located in peripheral devices may be inspected. If CD ROMs or disk drives are used, these must also be read and verified, requiring a significant amount of time. A thorough inspection program will, of necessity, be extended in scope to include hardware since the device must be searched for approved peripherals that may modify the source code execution and function of the game. Hardware inspections are not easily defined, requiring a high level of technical skill for field personnel. Even if this capability is provided, each inspection will be time intensive thereby significantly reducing the effectiveness of any inspection program.

Even with these efforts, validation will not be absolute. Regardless of the extent of the inspection, it is impossible to guarantee that an approved program is actually executing from dynamic RAM. Large jackpot validations by the casino are also out of the question for the same reason. This is a result of the fact that programs executing in dynamic RAM are self modifiable and extremely difficult to extract from an operating device. The dynamic RAM only exists in an active operating context; therefore it is impossible to be sure of an accurate program validation during an evaluation to resolve questionable operation or a patron dispute.

At a time when regulatory goals should be to enhance slot machine security to protect the integrity of gaming, the introduction of these types of devices is an antithesis. These devices are an invitation to highly technical and non-detectable compromise by experts. At first, it may seem restrictive to prevent this type of design by regulation. However, multi media capabilities which can be offered via today's high technology can provide a very marketable scheme to patrons, therefore, alternative designs must be considered to provide these features in a responsible manner.

Therefore, a need exists for an independent secured processor design for validation which would provide all key functions such as the determination of game outcome, monetary input, output, and logging of relevant events. Furthermore, a need exists for an open architecture design, for example, a personal computer based design of the gaming device which would provide all shell functions of presenting the game environment and thus providing a substantial entertainment component of the gaming device. Therefore, even though compromise is still possible at the shell level, evidence of what should have occurred is recoverable from the specially designed secured processor.

SUMMARY OF THE INVENTION

The present invention is distinguished over the known prior art in a multiplicity of ways. For one thing, the present invention provides a video and slot gaming device security system including two processing areas linked together via a secure protocol. In addition, the present invention includes

a non-alterable storage media having gaming critical functions, at a minimum, stored therein and executed from the non-alterable media by one of the two processing areas. The other processing area of the present invention includes an open architecture design which is expandable without compromising the critical gaming functions. Thus, the present invention encourages innovations of gaming devices without reducing the effectiveness of regulatory evaluation and validation processes of the critical gaming functions. Furthermore, the present invention allows for correlating true game results and monetary transactions to player presentation under suspicious circumstances, even if the open architecture processing area is tampered with.

In one preferred form, the present invention includes at least one video and/or slot gaming device. The gaming device is based around the secure processing area which includes a random number generator, an accounting and log means operatively coupled to a static or non-volatile random access memory and an EPROM having stored therein the critical gaming functions. Preferably, a coin acceptor, a bill validator and a hopper are operatively coupled to the secured processing area. In addition, the present invention includes the open architecture processing area linked to the secure processing area and communicating therewith via the secure protocol. Furthermore, a display means is operatively coupled to a visual display for displaying, inter alia, random outcomes.

The open architecture design includes an internal alterable program storage media operatively coupled to a dynamic ram. Thus, the open architecture processing area allows for the storage of, inter alia, interactive multi media gaming functions.

In one scenario, at least one gaming device is actuated by inserting a coin in the coin acceptor or a bill in the bill validator. Gaming activity is then initiated by the player and a gaming outcome is influenced by the random number generator. The gaming outcome is then transmitted to the open architecture processing area to be animated on the visual display operatively coupled to the open architecture processing area. If the gaming outcome is a winning outcome the secure processor communicates with or drives the hopper so that a player winning on the gaming device can receive money back from a dispensing tray. Alternatively, the secure processing area may be provided with means to bestow credits as a function of the random gaming outcome.

The critical gaming functions of the present invention are stored in and executed directly from a media which is not alterable through any use of circuitry or programming of the gaming device itself and are verifiable as to content independent of any function of the gaming device. Critical gaming functions include a unique control of, or any interruption of signals from a component involved in a monetary transaction, including, coin acceptors, bill validators, hoppers, interfaces to cashless wagering systems, associated equipment used in the determination of a progressive or bonus award value or any device which provides for the input or collection of credits, wagers or awards. In addition, critical gaming functions also include all accounting functions including the direct and unique control of electromechanical and electronically stored meters, and the result of the random number generator utilized in determining game outcome. Furthermore, critical gaming functions include a unique control over a storage and retrieval of a historical log documenting credits, wagers, award transactions, random values used in determining game outcome and any security or error events for the most recent game player or games in progress and a plurality of games prior to the current or most recent game. This log is to be maintained in tact for a predetermined minimum period of time and after a power loss to the gaming device.

Furthermore, critical gaming functions may be partitioned from other functions by executing critical gaming functions on a separate dedicated processor and partitioning the devices hardware so that the functions not deemed critical which are stored or executed from alterable media are not capable of directly modifying the random access memory used by the critical gaming functions. Any component required to be uniquely controlled by the critical gaming functions are preferably not accessible by other functions stored or executed from alterable media. Thus, the non-alterable media containing the critical gaming functions is easily verifiable as to content independent of any function of the gaming device itself.

OBJECTS OF THE INVENTION

Accordingly, it is an object of the present invention to provide a new and novel gaming device security system: apparatus and method.

A further object of the present invention is to provide a gaming device security system as characterized above which includes two processing areas wherein a second processing area is sequestered for securing critical gaming functions and a first processing area is of an open architecture design expandable without any interference or access to the critical gaming functions stored within the second processing area.

Another further object of the present invention is to provide a system as characterized above which provides a security link operatively coupled between the first processing area and the second processing area for transmitting encrypted data correlative to critical gaming functions between the second processing area and the first processing area.

Another further object of the present invention is to provide a gaming device security system as characterized above which includes an accessible access means for coupling an external program validation device to an electronically programmable read only memory included in the second processing area.

Another further object of the present invention is to provide a gaming device security system as characterized above which includes an accessible access means for operatively coupling an external device validation process means to a static/battery backed random access memory included in the second processing area for validating suspicious jackpots and/or disputes.

Another further object of the present invention is to provide a gaming device security system as characterized above which precludes counterfeiting, tampering or modification of critical gaming functions including random outcomes and accounting logs of gaming results.

Another further object of the present invention is to provide a gaming device security system as characterized above which can be operatively coupled to an external source for downloading software into the gaming device.

Another further object of the present invention is to provide a gaming device security system as characterized above which includes a visual display for displaying decrypted random gaming outcome from the first processing area which has been transmitted thereto in an encrypted form by the second processing area via a security protocol.

Another further object of the present invention is to provide a gaming device security system as characterized

above including a non-alterable memory means for storing critical gaming functions therein.

Another further object of the present invention is to provide a gaming device security system as characterized above which includes a security protocol for transmitting all critical gaming functions over a link coupling the first processing area with the second processing area.

Viewed from a first vantage point, it is an object of the present invention to provide a gaming machine comprising, in combination: a first processor having a visual display and a communication interface; a second processor sending communicating data with the first processor via the communicating interface, the second processor having means for sensing wagering activity and means for transmitting a random gaming outcome to the first processor to be animated on the visual display, the second processor provided with means to bestow credits as a function of the random gaming outcome.

Viewed from a second vantage point, it is an object of the present invention to provide a method for providing gaming security, the steps including: sequestering gaming functions into two processing areas, and linking the two processing areas via a security protocol.

Viewed from a third vantage point, it is an object of the present invention to provide a gaming device security system operatively coupled to at least one gaming machine, the system comprising in combination: a first processing means operatively coupled to and driving a visual display; a second processing means operatively coupled to the first processing means and communicating therewith via a secure protocol; a plurality of inputs enabled by a player allowing the player to initiate and sustain game play on at least the one gaming machine; the second processing means including means for determining random outcomes of game play and means for transmitting the outcomes to the first processing means for updating the visual display; a player memory card including memory storage means on the card removable from and accessible by to the second processing means to upload and download information between the second processing means and the player memory card reflective of status of an ongoing game.

Viewed from a fourth vantage point, it is an object of the present invention to provide a gaming device security system, comprising in combination: a first processor; a second processor including a non-alterable memory means for storing critical gaming functions therein; a communication link operatively coupled to the first processor and the second processor for transmitting encrypted data packets correlative of the critical gaming functions and outcomes.

These and other objects will be made manifest when considering the following detailed specification when taken in conjunction with the appended drawing figures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic depiction of the present invention according to one form.

FIG. 2 is a plan front view of a gaming machine.

FIG. 3 is a flow chart of a method according to one form of the present invention of a typical game sequence of the second processing area.

FIG. 4 is a flow chart of a typical poll processing logic method of the first processing area according to one form of the present invention.

FIG. 5 is a flow chart of typical poll processing logic method of the second processing area according to one form of the present invention.

FIG. 6 is a detailed block diagram of the second processing area according to one form of the present.

FIG. 7 is a detailed block diagram of a first processing area according to one form of the present.

FIG. 8 is a drawing reflecting the interaction between a player memory card and a source of uploading and downloading.

DESCRIPTION OF PREFERRED EMBODIMENTS

Considering the drawings, wherein like reference numerals denote like parts throughout the various drawing figures, reference numeral **10** is directed to the gaming device security system according to the present invention.

In its essence, and referring to FIGS. **1** and **2**, the gaming device security system **10** is preferably housed within a gaming device **100** which may take the form of, for example, a video and/or a mechanical reel type slot machine. The gaming device security system **10** includes a first processing area **20** and a second processing area **60** operatively coupled to one another via a communication link **30**. The communication link **30** provides the means for transmitting encrypted data, correlative to critical gaming functions, between the second processing area **60** and the first processing area **20**. The first processing area **20** is operatively coupled to a visual display **50** for displaying, inter alia, gaming graphics and random gaming outcomes. The second processing area **60** of the system **10** includes means for sensing wagering activity and means for transmitting the random gaming outcomes to the first processing area **20** such that the outcome is animated on the visual display **50**. In addition, the second processing area **60** includes means to bestow credits and/or monitory awards as a function of the random gaming outcome. Furthermore, the second processing area **60** can be directly accessed for validating the outcome of any game and the outcome can be displayed on the visual display **50**, on an LCD display **55** or presented visually or audibly or any other peripheral.

More specifically, and referring to FIGS. **1** and **2**, the gaming device security system **10** is operatively coupled to at least one video and/or slot gaming device **100**. FIG. **2** shows an example of a video slot device **100** supporting the visual display **50** and including the coin acceptor **52**, the bill validator **54**, a cash out button **102**, a service button **104**, a bet one button **106**, a display of features button **108** having scroll buttons **110**, **112** disposed on either side, a spin reel button **114** and a play max button **116**. In addition, the video slot device **100** includes a card reader **122**, a card reader display **120** and a manual eject button **124**.

The gaming device **100** is founded on the first and second processing areas **20**, **60** linked together via a secure protocol. The first processing area **20** is of an open architecture design which includes an internal alterable program storage media **24** operatively coupled to a dynamic RAM means **26**. Thus, the open architecture design of the first processing area **20** allows for the storage of, inter alia, interactive multi-media gaming functions. In addition, the first processing area **20** may be operatively coupled to an external source, for example, a remote computer **140** for downloading software into the gaming device **100** with out having access to or interfering with critical gaming functions stored in the second processing area **60**. In addition, the first processing area **20** is operatively coupled to a visual display **50** for providing visual feedback to a gaming player.

The second processing area **60** is a secure processing area which includes, a watchdog circuit **61**, a random number

generator **62**, an accounting and log means **64** operatively coupled to a static or non-volatile random access memory **66** and an electronically programmable read only memory **68** having stored therein the critical gaming functions. The second processing area **60** is operatively coupled to the visual display **50**, a coin acceptor **52**, a bill validator **54**, a hopper **56** and electro-mechanical meters **58** which are preferably supported by the gaming device **100**. In addition, the second processing area is coupled to associated gaming equipment **120** used in the determination of a progressive or bonus award value. The second processing area **60** is linked to the first processing area **20** with a communication link **30** which provides the link for transmitting data via the security protocol thereby precluding any alteration of the critical gaming functions.

The critical gaming functions are stored in and executed directly from the read only memory **68** which is not alterable through any use of circuitry or programming of the gaming device **100** itself and are verifiable as to content independent of any function of the gaming device **100**.

Critical gaming functions preferably include a unique control of, or any interruption of signals from a component involved in a monetary transaction, including, coin acceptors, bill validators, hoppers, interfaces to cashless wagering systems, associated equipment used in the determination of a progressive or bonus award value or any device which provides for the input or collection of credits, wagers or awards. In addition, critical gaming functions also include all accounting functions including the direct and unique control of electromechanical and electronically stored meters, and the result of the random number generator utilized in determining game outcome. Furthermore, critical gaming functions include a unique control over a storage and retrieval of a historical log documenting credits, wagers, award transactions, random values used in determining game outcome and any security or error events for the most recent game player or games in progress and a plurality of games prior to the current or most recent game. This log is to be maintained in tact for a predetermined minimum period of time and after a power loss to the gaming device.

Furthermore, critical gaming functions are partitioned from other functions by executing critical gaming functions on the second processing area **60**. Functions not deemed critical may be stored or executed from the alterable media **24** which is not capable of directly modifying the random access memory **66** or the electronically programmable read only memory **68** used by the critical gaming functions. Any component required to be uniquely controlled by the critical gaming functions are preferably not accessible by other functions stored or executed from the alterable media **24**. Thus, the non-alterable media containing the critical gaming functions is easily verifiable as to content independent of any function of the gaming device **100** itself.

In general, the gaming device **100** is actuated by, for example, inserting a coin in the coin acceptor **52** or a bill in the bill validator **54**. Gaming activity is then initiated by the player and a gaming outcome is influenced by the random number generator **62**. The gaming outcome is then transmitted, via the secure protocol, to the open architecture processing area **20** and animated on the visual display **50**. If the gaming outcome is a winning outcome the second processing area **60** communicates with or drives the hopper **56** so that a player winning on the gaming device **100** can receive money back from a dispensing tray **48**. Alternatively, the secure processing area may be provided with means to bestow credits as a function of the random gaming outcome. The credits are preferably displayed to the player via the display **50**.

More specifically, and referring to FIG. **3**, the first processing area **20** may be referred to as a white box while the second processing area **60** may be referred to as a black box. With this terminology in mind one method of a typical game sequence with respect to the black box can be explored. Initially, a player places funds into the gaming device **100** via the coin acceptor **52**, bill validator **54** or by inserting a card into a card reader **122**. The player further interacts with the gaming device **100** by placing a bet by actuating the bet one button **106**, placing a max bet by actuating the play max button **116**, actuating game play via, for example pushing the spin reel button **114**, or inserting further funds into the gaming device **100**.

If a bet is placed, the second processing area **60** determines if the number of credits is greater than zero and if so increments the wager amount and decrements the credits which the player holds. The amount of the wager is then transmitted to the first processing area **20** or white box in an encrypted format such that the white box can update the visual display means **50**. Once this transmission has been completed the second processing area or black box determines whether the wager amount is equal to a predetermined max bet amount. If the wager amount is equal to the max bet amount the black box determines the game outcome and increments all meters associated therewith. This game outcome is then transmitted in an encrypted form via the communication link **30** to the first processing areas **20** or between the black and white box. Once the outcome has been transmitted to the white box a query for an end of game display sequence is sent to the white box and this transmission continues until the display sequence is complete. Once the display sequence is complete the visual display is updated accordingly, the game sequence loops back to a subsequent start of game.

Alternatively, if a max bet means is initially actuated, the second processing area **60** determines if the number of credits the player has is greater than or equal to the predetermined amount of the max bet. If the player does not have enough credits to cover the max bet the black box remains at the start of the game sequence. If the player has enough credits to cover the max bet the wager amount is incremented while the player's credit amount is decremented. The amount of the wager is then transmitted to the first processing area **20** or white box in an encrypted format via the communication link **30**. The first processing area **20** then updates the visual display **50** accordingly. The game outcome is then determined and all meters associated with the gaming device **100** are incremented if necessary. This game outcome is then transmitted in an encrypted form via the communication link **30** to the first processing area **20** or between the black and white box and the white box then updates the visual display means **50**. Once the game outcome has been determined and displayed a query for an end of game display sequence is looped into action and displayed on the visual display **50** until the display sequence is complete. Once the display sequence is complete the visual display is updated accordingly and the game sequence loops back to a subsequent start of game.

At the start of any game sequence the player has the option of actuating game play by, for example, pushing a spin or draw button which will result in the black box determining the outcome of the game if the player has placed a wager amount which is greater than zero. If the player has not placed a wager the black box will remain in the start of the game sequence. However, if the player has placed a wager the outcome of the game is determined and then transmitted to the white box in an encrypted form via the

communication link **30**. Once again a query for end of game display sequence is looped into action and displayed on the display **50** until the sequence is completed and then subsequently the visual display **50** is updated and a new start of game sequence is initiated.

Initially inserting funds into the gaming device **100** causes the wager amount to be incremented and transmitted to the white box in an encrypted form such that the white box will update the visual display **50**. Inserting further funds into the gaming device **100** without actuating a bet, max bet or game play option will cause this process to continue until the insertion of funds has equaled the max bet amount. When this occurs the game is actuated and the outcome is determined. This outcome increments all associated gaming meters and is sent to the white box in an encrypted form which in turn initiates the query for the end of game display sequence to be initiated on the visual display **50**. This continues until the display sequence is complete. Once the display sequence is completed the visual display is updated and the start of game sequence is initiated.

FIGS. **4** and **5** detail a poll processing logic method between the black box side and the white box side, the two processing areas **20**, **60**, of the system **10**.

Referring to FIG. **4**, when a message is be sent from the black box to the white box the black box increments a message sequence number and resets a retry counter included in the second processing area **60**. Next, the black box **60** builds an encrypted message and transmits this message via the communication link **30**. In addition, the black box starts a message timer and a byte timer included in the second processing area **60**.

Meanwhile, and referring to FIG. **5**, the white box **20** tests for incoming data words. When an incoming data word is found the white box decrypts the transmitted message and builds a message packet. The white box continues to receive the incoming data word and decrypts and builds the message packet until the message packet is complete. Once the message packet is complete the white box determines if the decrypted message packet is valid and if so then discerns whether the message itself is of a valid type. Once the white box has validated the message packet and determined that the message is a valid one it processes the message and constructs a response. The response is encrypted and sent back to the black box side. Alternatively, if the white box determines that the packet is invalid or that the message type of the packet is invalid it sends a negative acknowledgment to the black box side.

Referring back to FIG. **4**, The black box determines if the white box is sending a response in the form of an incoming data word. If the black box discerns that the white box is sending a data word the black box receives the data word and restarts the byte timer. The black box then decrypts the data word and starts to build a message packet. The black box will check this message packet and if the message packet is incomplete it will continue to receive the incoming data word from the white box and will restart the byte timer after each check of the message packet. This continues until the message packet is complete. Once the message packet is complete the black box discerns whether a negative acknowledge message has been sent by the white box and if a negative acknowledge message has not been sent by the white box the black box discerns whether the packet is a valid packet and also discerns whether the packet contains a valid message type. If both criteria are met the transmission of the response is complete.

Alternatively, if the message packet built by the black box is not a valid packet or if the message type within the packet is not valid, the black box will increment the retry counter and re transmit the original message to the white box. As long as each incoming message packet built by the black box is not a valid packet or if the message type within the packet is not valid message the black box will increment the retry counter and re transmit the original message to the white box until the retry counter has a value which is greater than a maximum allowable value. Once the maximum allowable value of the retry has been obtained an error message will be displayed on the visual display and once again a communication error process will be initiated.

Alternatively, if the incoming data word from the white box to the black is a negative acknowledge message the black box will continue to increment the retry counter and re transmit the message until the retry counter is greater than a maximum allowable value. Once the retry counter reaches a value which is greater than maximum allowable value an error condition is displayed on the visual display and system **10** initiates a communication error process to discern why the negative acknowledge message is being sent.

If the response from the white box is not an incoming data word and a message timer and a byte timer is less than predetermined values the black box will continue to poll for an incoming word. If the black box is receiving a response from a white box which is not an incoming data word and the message timer and the byte timer are greater than predetermined values the black box will increment the retry counter and re transmit the message to the white box. The black box will continue this process until the retry counter is greater than a maximum allowable value. Once the retry counter reaches a value which is greater than maximum allowable value an error condition is displayed on the visual display and system **10** initiates a communication error process to discern the cause of the error.

In the preferred embodiment, the second processing area is the master communication device and initiates all messages. The first processing area is the slave and transmits data only when polled by the master. All message data shall be encrypted to provide data security. Preferably, each incoming data word includes a unique identification signature which includes at least one leading bit and at least one trailing bit attached to the ends of the data word. By checking the leading and trailing bits of each data word the system can discern the validity of the identification signature of each data word. Alternatively, each completed packet can include a unique identification signature which includes at least one leading bit and at least one trailing bit attached to the ends of the message. By checking the leading and trailing bits of each message the system can discern the validity of the identification signature of each message.

The gaming device **100** includes an input/output device **122** for reception of a player memory card **280** that the device **100** can read and write to. The device may also include a separate stand alone station where the player can take the player memory card for a status diagnostic including the relative ranking of the player during the course of play or at the end of the set period for play including an opportunity to redeem awards associated with player performance.

More particularly, and with reference to FIGS. **1** and **2**, the gaming device **100** is shown according to one form of the invention. The gaming device **100** includes a housing **101** that supports therewithin, a display **50** to an area for receiving a wager **52**, **54** a place **122** to receive a player memory card, a display **120** that allows supplemental information to be received thereon, a plurality of decision making buttons

102 through 116 and optionally a handle which can be used in lieu of one of the decision making buttons in order to initiate play of the game. In addition, a payout hopper 56 can be included for a redeeming awards based on play in using the gaming device 100.

FIG. 8 reflects details of the player memory card 280 and its relationship to a read/write machine interface 122 that receives the player memory card 280. More particularly, the player memory card 280 can be configured as a substantially plan rectangular piece of plastic which can include encoding on a magnetic strip includes an input/output interface 284 that can be read by the read/write machine interface 122 shown in FIG. 8. In essence, the input/output interface 284 is operatively coupled to an integrally formed processor or storage unit 286 contained in the player memory card 20 and the processor or storage unit 286 interfaces with an electrically erasable programmable read only memory 288 or other black box circuitry so that the ongoing status of the player's gaming activities can be uploaded and downloaded to and from the machine 100. In addition, automatic downloading of the player's descriptive information (name, address, social security number, etc.) is preferably accomplished when the memory card is in the read/write machine interface 122. This information is used for, inter alia, marketing use by the casino. The magnetic strip 282 can include other information if desired, such as player identification or a form of encryption for detecting the validity of the player memory card 280. In addition, the processor 286 and its memory 288 can be included with encryption or decoding means so that appropriate "handshaking" can occur between the machine interface 121 and the card 280 to minimize the likelihood of cards which have been updated by an improper unauthorized technique.

In use and operation, and referring to FIG. 6, the secure processing area 60 includes a processor board 162, a main board 164 and a back plane 166 integrally or separately formed. The processor board 162 includes a graphics system processor 168 which is operatively coupled to the main board 164. The main board 164 preferably includes memory in the form of ROM, RAM, flash memory and EEPPROM (electrically erasable programmable read only memory). The ROM includes the EPROM 68. In addition, the main board 164 includes a system event controller, the random number generator 62, a win decoder/pay table, status indicators, a communications handler and a display/sound generator.

The main board 164 is operatively coupled to the back plane 166 which includes memory preferably in the form of an EEPROM and connectors to connect to peripherals. Furthermore, the back plane 166 provides a plurality of communication ports for communicating with external peripherals. The back plane 166 provides the coupling between discrete inputs 170 and the processor 168 and main board 164. Typical examples of elements which provide discrete inputs are coin acceptors, game buttons, mechanical hand levers, key and door switches and other auxiliary inputs. Furthermore, the back plane 166 provides the coupling between discrete outputs 172 and the processor and main board 164. Typically, elements which provide discreet outputs are in the form of lamps, hard meters, hoppers, diverters and other auxiliary outputs.

The back plane 166 also provides connectors for at least one power supply 174 for supplying power for the second processing area 60 and a parallel display interface "PDI" 176 and a serial interface for linking with the first processing area 20. The communication link 30 between the black box and the white box is via the parallel display interface 176 and/or the serial interface 178. In addition, the back plane 166 also provides connectors for a sound board 180 and a high resolution monitor 182. Furthermore, the back plane 166 includes communication ports for operatively coupling and communicating with an accounting means 184, a touch screen 186, the bill validator 54, a printer 188, an accounting network 190, a progressive current loop 192 and an auxiliary serial link 194.

The back plane 166 optionally includes connectors for external video sources 200, expansion busses 202, slot or other display means 204, a SCSI port 208 and the card reader 122 and key pad 123. The back plane 166 also preferable includes means for coupling a plurality of reel driver boards 220 which drive physical slot reels 222 with a shaft encoder or other sensor means to the processor 168 and main board 164.

Referring to FIG. 7, the white box can be an interactive multi-media gaming computer which includes the first processing area 20. The first processing area 20 includes an input/output parallel and serial card 22. The input/output card 22 is operatively coupled to a first processing area processor board 252. The processor board 252 preferably includes memory in the form of read only memory, the dynamic random access memory 26 and internal alterable program storage media 24, for example, flash memory and electrically erasable programmable read only memory. In addition, the processor board 252 includes a communications handler, a display output generator and a sound output generator. The processor board 162 is operatively coupled to a video card 250 with video memory which in turn is operatively coupled to the visual display means 50.

The processor board also allows peripherals in the form of, for example, hard drives 254, CD ROMS 256, network interfaces 258, sound cards 260 and other desirable peripherals 262 for game enhancement and patron entertainment.

Moreover, having thus described the invention, it should be apparent that numerous structural modifications and adaptations may be resorted to without departing from the scope and fair meaning of the instant invention as set forth hereinabove and as described hereinbelow by the claims.

We claim:

1. A gaming machine, comprising, in combination:

a first processor having open architecture to allow reception of game formats, a visual display and a communication interface;

a second processor sending encrypted communicating data with said first processor via said communicating interface, said second processor having closed architecture which precludes access to critical gaming functions and programs;

said second processor having means for sensing wagering activity and means for transmitting a random gaming outcome to said first processor to be animated on said visual display;

said second processor provided with means to bestow credits as a function of the random gaming outcome.

2. The gaming machine of claim 1 wherein said second processor includes a non-alterable memory means for said storing critical gaming functions therein.

3. The gaming machine of claim 2 wherein said second processor includes a random access memory for storing accounting and gaming outcome information therein.

4. The gaming machine of claim 2 wherein said non-alterable memory means includes an interface to couple with an external program validation device.

5. The gaming machine of claim 4 wherein said random access memory of said second processor includes means for

interfacing with an external device validation process for directly validating the outcome of any game.

6. The gaming machine of claim 1 wherein said second processor includes a random number generator for determining the random gaming output.

7. The gaming machine of claim 1 wherein said first processor includes an alterable program storage media for storing interactive multi-media gaming functions downloaded from a remote source without interfering with critical gaming programs and functions stored in the second processing area.

8. A method for providing gaming security, the steps including:

sequestering gaming functions into two processing areas within one gaming machine, and

linking the two processing areas via a security protocol, one said processing area having open architecture, the other said processing area having closed architecture.

9. The method of claim 8 including forming said two processing area into a first processing area and a second processing area,

providing the first processing area with player stimulus,

providing the second processing area with a response from the player as a function of player stimulus, and having the second processing area drive the first processing area as a result of player response.

10. A gaming device security system operatively coupled to at least one gaming machine, the system comprising, in combination:

a first processing means operatively coupled to and driving a visual display and having open architecture;

a second processing means having closed architecture operatively coupled to said first processing means and communicating therewith only via a secure protocol;

a plurality of inputs enabled by a player allowing the player to initiate and sustain game play on at least the one gaming machine;

said second processing means including means for determining random outcomes of game play and means for transmitting said outcomes to said first processing means for updating said visual display;

a player memory card including memory storage means on said card removable from and accessible by said second processing means to upload and download information between said second processing means and said player memory card reflective of status of an ongoing game, whereby a player can discontinue play by storing game information on said memory card and subsequently resume play in progress by refreshing said second processor means in said system.

11. A gaming device security system, comprising in combination:

a first processor having open architecture;

a second processor having closed architecture including a non-alterable memory means for storing critical gaming functions therein;

a communication link operatively coupled to said first processor and said second processor for transmitting encrypted data packets correlative of said critical gaming functions and outcomes.

12. The system of claim 11 wherein said encrypted data packets include an encrypted data message and a unique identification signature to be validated upon receipt.

13. The system of claim 12 wherein said unique identification signature includes at least one leading bit and at least one trailing bit attached to ends of said data message.

14. The system of claim 13 further including means for checking said leading and said trailing bits of each data packet for validity of the identification signature.

15. The system of claim 14 further including means for validating each data message of each data packet.

16. A gaming device for use by a player comprising:

a visual display accessible to a player;

a first processing area having an open architecture with respect to application programming and including a microprocessor and an alterable storage media capable of being externally alterable without affecting a key game function of determining a random game outcome, said first processing area coupled to and driving said visual display;

a second processing area having a closed architecture including a non-alterable media for performing said key gaming function of determining a random game outcome, said non-alterable media being secure so as to retain the ability for regulatory validation;

an electrical path connecting said first and second processing areas for communication of said random game outcome.

17. The gaming device of claim 16 wherein said first processing area includes display software for determining visual graphics on said visual display; and

wherein said first processing area is externally alterable via downloading of display software from a source distinct from said second processor.

18. The gaming device of claim 16 wherein said second processing area includes a microprocessor.

19. The gaming device of claim 16 wherein said second processing area includes a non-volatile random access memory.

20. The gaming device of claim 19 wherein said non-volatile random access memory stores game outcome information.

21. The gaming device of claim 16 wherein said second processing area includes a random number generator for determining said random game outcome.

22. The gaming device of claim 16 further including an interface for connection with an external validation device.

23. The gaming device of claim 16 wherein said second processing area senses wagering activity.

24. The gaming device of claim 17 wherein said second processing area bestows credits as a function of said random game outcome.

25. The gaming device of claim 16 wherein said gaming device is configured as a slot machine.

26. The gaming device of claim 16 wherein said electrical path is a communication link.

27. The gaming device of claim 26 wherein said communication link is a serial communication link.

28. The gaming device of claim 16 wherein said gaming device is connectable to an external validation device; and

wherein said non-alterable media is capable of validation by the external validation device.

* * * * *

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(12) **United States Patent**
Szrek et al.

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(45) **Date of Patent: Apr. 9, 2002**

(54) **SYSTEM AND METHOD FOR DETERMINING WHETHER WAGERS HAVE BEEN ALTERED AFTER WINNING GAME NUMBERS ARE DRAWN**

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(52) **U.S. Cl.** **463/42**; 463/25
(58) **Field of Search** 463/17, 18, 25, 463/26, 27, 28, 29, 42; 380/251

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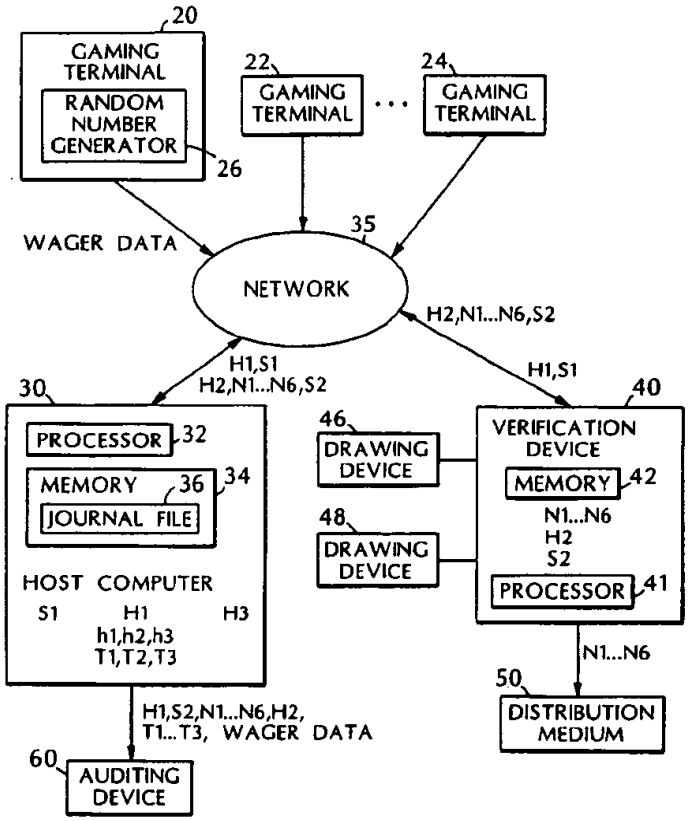
(57) **ABSTRACT**

A system and method for determining whether wager data for players' wagers placed on a drawing game have been altered after winning game elements are drawn includes a host computer and a verification device. The host computer stores the wager data and generates a first hash value for the wager data at a time prior to drawing the winning game elements. The host computer is capable of generating a second hash value for the wager data at a time subsequent to drawing the winning game elements for comparison to the first hash value. The verification device receives the first hash value for the wager data prior to drawing the winning game elements and receives the winning game elements.

21 Claims, 3 Drawing Sheets



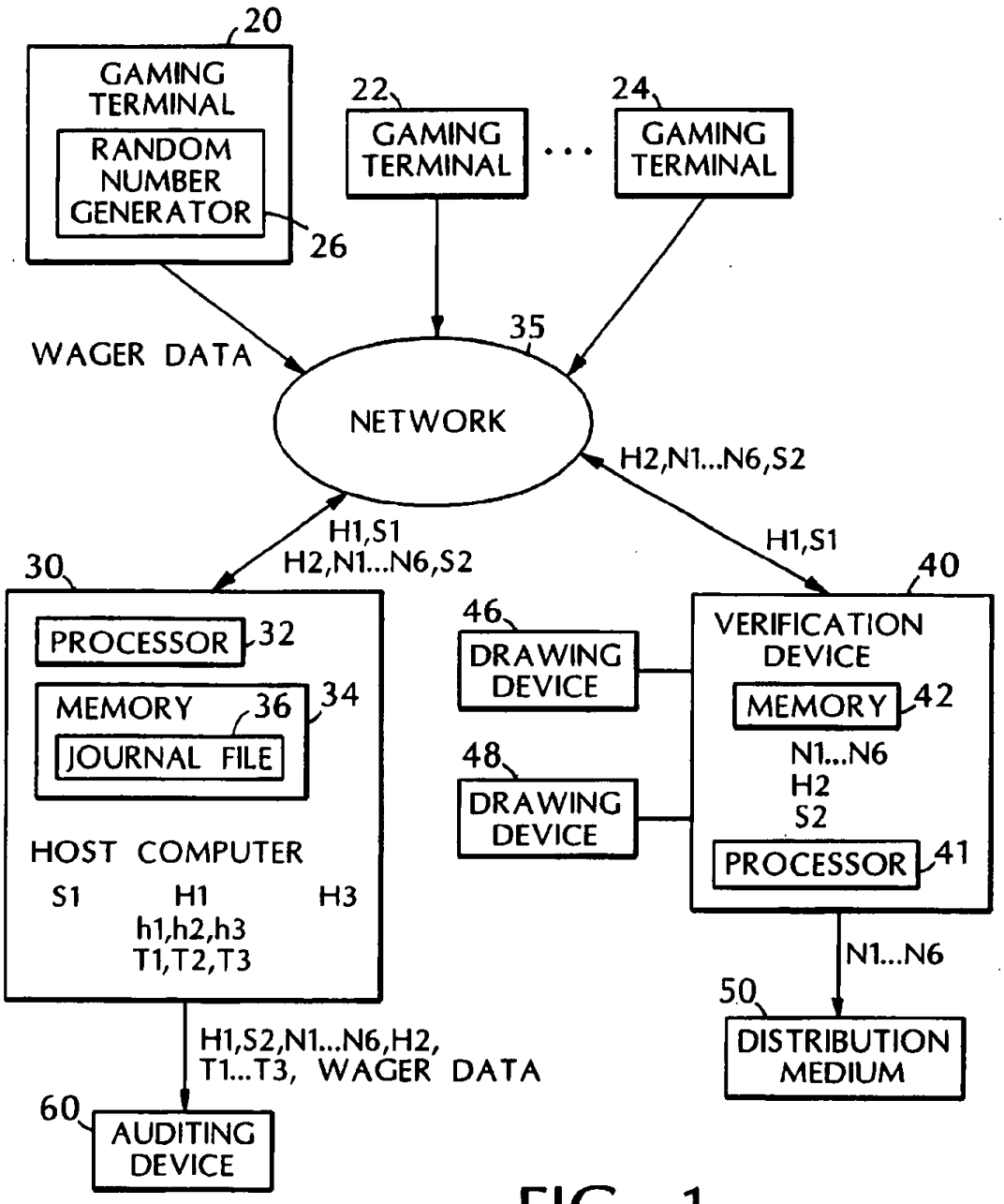

20
GAMING TERMINAL
RANDOM NUMBER GENERATOR
26
22
GAMING TERMINAL
24
GAMING TERMINAL
WAGER DATA
35
NETWORK
H2,N1...N6,S2
H1,S1
H2,N1...N6,S2
H1,S1
30
PROCESSOR
32
MEMORY
36
34
JOURNAL FILE
HOST COMPUTER
S1 H1 H3
h1,h2,h3
T1,T2,T3
46
DRAWING DEVICE
48
DRAWING DEVICE
40
VERIFICATION DEVICE
MEMORY
42
N1...N6
H2
S2
PROCESSOR
41
N1...N6
50
DISTRIBUTION MEDIUM
H1,S2,N1...N6,H2,
T1...T3, WAGER DATA
60
AUDITING DEVICE

FIG. 1

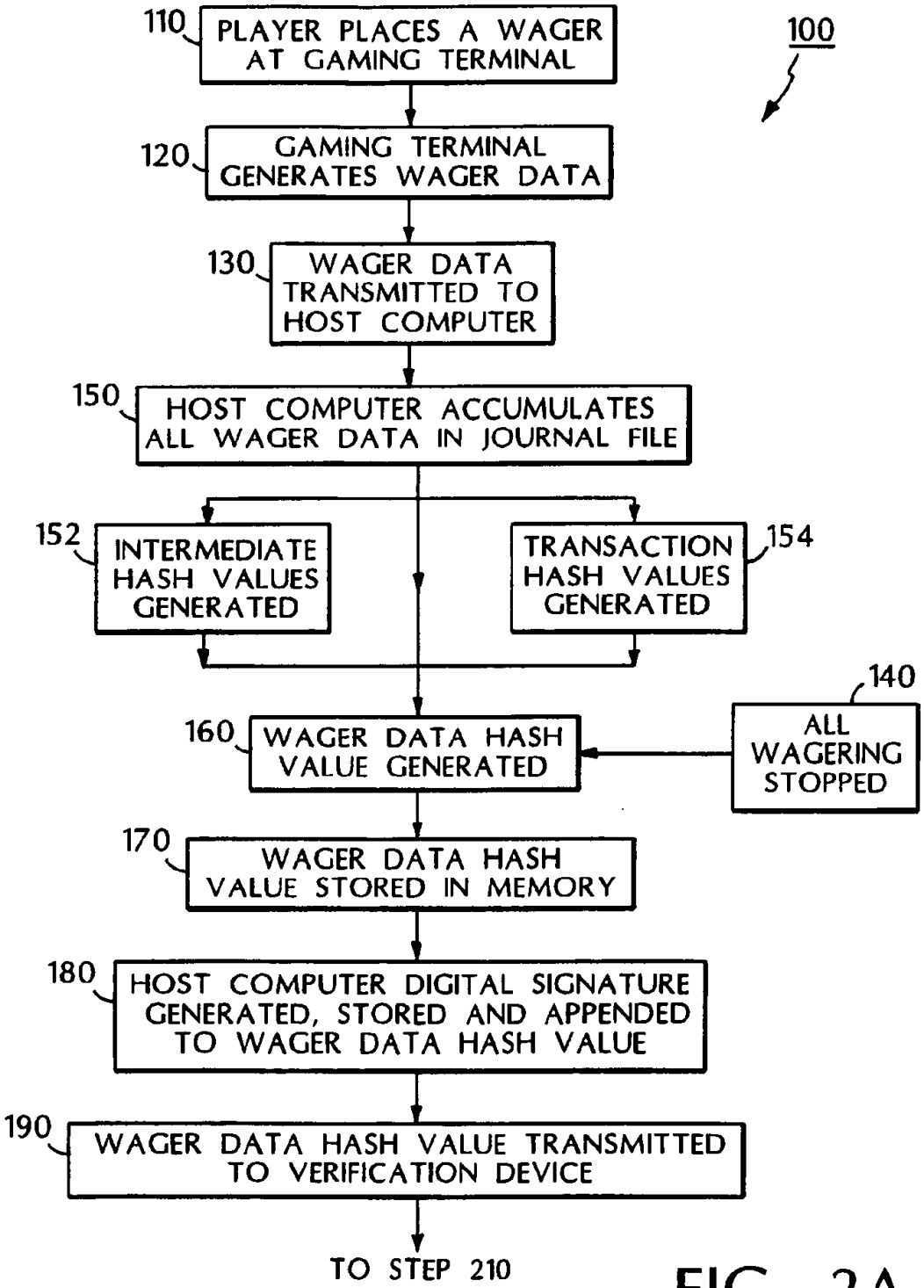

100
110
PLAYER PLACES A WAGER AT GAMING TERMINAL
120
GAMING TERMINAL GENERATES WAGER DATA
130
WAGER DATA TRANSMITTED TO HOST COMPUTER
150
HOST COMPUTER ACCUMULATES ALL WAGER DATA IN JOURNAL FILE
152
INTERMEDIATE HASH VALUES GENERATED
154
TRANSACTION HASH VALUES GENERATED
140
ALL WAGERING STOPPED
160
WAGER DATA HASH VALUE GENERATED
170
WAGER DATA HASH VALUE STORED IN MEMORY
180
HOST COMPUTER DIGITAL SIGNATURE GENERATED, STORED AND APPENDED TO WAGER DATA HASH VALUE
190
WAGER DATA HASH VALUE TRANSMITTED TO VERIFICATION DEVICE
TO STEP 210

FIG. 2A

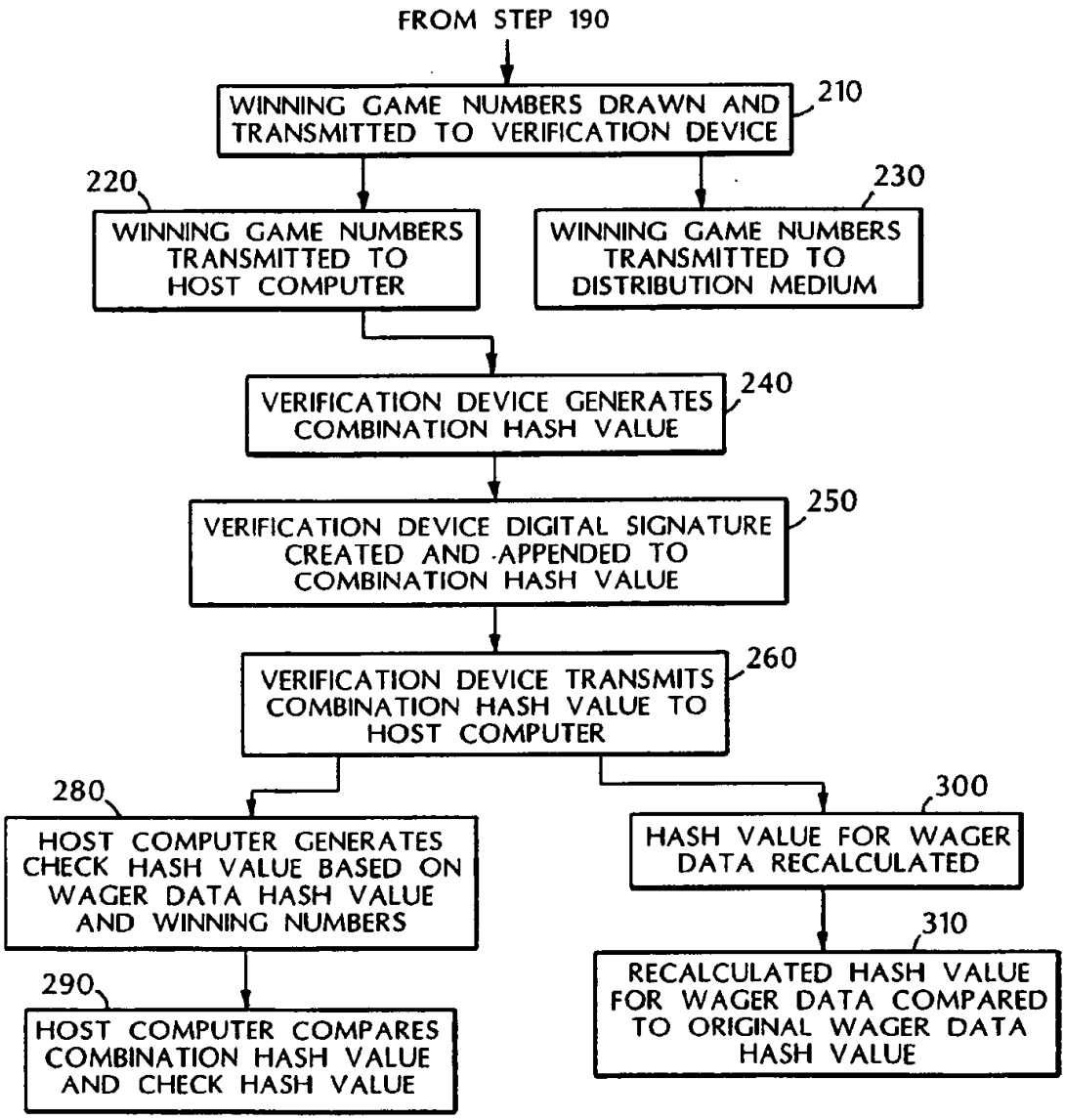

FROM STEP 190
WINNING GAME NUMBERS DRAWN AND TRANSMITTED TO VERIFICATION DEVICE
210
220
WINNING GAME NUMBERS TRANSMITTED TO HOST COMPUTER
230
WINNING GAME NUMBERS TRANSMITTED TO DISTRIBUTION MEDIUM
VERIFICATION DEVICE GENERATES COMBINATION HASH VALUE
240
VERIFICATION DEVICE DIGITAL SIGNATURE CREATED AND APPENDED TO COMBINATION HASH VALUE
250
VERIFICATION DEVICE TRANSMITS COMBINATION HASH VALUE TO HOST COMPUTER
260
280
HOST COMPUTER GENERATES CHECK HASH VALUE BASED ON WAGER DATA HASH VALUE AND WINNING NUMBERS
290
HOST COMPUTER COMPARES COMBINATION HASH VALUE AND CHECK HASH VALUE
300
HASH VALUE FOR WAGER DATA RECALCULATED
310
RECALCULATED HASH VALUE FOR WAGER DATA COMPARED TO ORIGINAL WAGER DATA HASH VALUE

FIG. 2B

SYSTEM AND METHOD FOR DETERMINING WHETHER WAGERS HAVE BEEN ALTERED AFTER WINNING GAME NUMBERS ARE DRAWN

BACKGROUND OF THE INVENTION

This invention relates to a system for playing a wagering game based on a drawing, and in particular, a system for determining whether wagers have been altered after winning game numbers are drawn.

Lottery and keno games are typical wagering games in which a gaming authority conducts periodic drawings of winning elements such as winning game numbers. In such games, each player selects a series of game elements, e.g., game numbers chosen from a set of numbers, which the player believes will be drawn during a subsequent drawing of winning game numbers from the set of numbers. For example, in a lottery game, a player may select six game numbers from the set of integers 1 through 40 which the player believes will match six winning game numbers drawn by the gaming authority. Similarly, in a keno game, a player may select 10 game numbers from the set of integers from 1 through 80 which the players believes will match 10 out of 20 numbers drawn by the gaming authority. Drawings for lottery games typically occur once or twice a week, while drawings for keno games can occur at intervals as short as several minutes.

Drawing games such as lottery and keno games are typically played using electronic gaming systems. Such electronic gaming systems include geographically dispersed gaming terminals for placing players' wagers. The terminals are connected to a host computer that usually records wagering information relating to the players' wagers in an electronic storage device such as a magnetic medium.

For security purposes, an electronic gaming system requires a mechanism for ensuring that existing wagering information is not altered after the drawing of winning game numbers to create a fraudulent wager containing game numbers that match the winning game numbers. The alteration may be any modification, deletion, addition or corruption of the wagering information. Several methods have been used to determine whether wagering information has been altered after a drawing of winning game numbers.

For games in which drawings occur once a day or less often, an electronic or printed copy of the wagering information for all wagers placed on the game can be made and secured at a remote location before the winning game numbers are drawn. At any time after the drawing, the secure copy of the wagering information can be compared to the wagering information stored in the host computer on a record-by-record basis to determine whether any alterations were made to the wagering information. This technique is time consuming, and is difficult to use with games in which drawings occur every few minutes.

A second technique involves use of an internal control system (ICS) connected to the host computer to perform auditing functions. In addition to recording the wagering information for every wager in the host computer, a copy of the wagering information for each wager is sent to the ICS. Before the winning game numbers are drawn, the ICS must assure that it has received a copy of all wagering information for the game. Thus, there must be no technical failures of the system or loss of communication between the gaming terminals and the host computer prior to the drawing. To perform the auditing function properly, the ICS must also be able to determine independently that the winning game numbers have not been drawn when the last wager is placed.

A third technique involves writing all wagering information to a fixed medium such as a write once removable media (WORM) drive. Once wagering information has been written to the WORM drive, it cannot be altered. This technique helps to prevent alteration of wagering information, but does not determine whether any alterations have been made prior to writing the wagering information to the WORM drive. A limitation of a WORM drive is that its use requires ensuring that all wagering information has actually been written to the WORM drive prior to drawing the winning game numbers.

SUMMARY OF THE INVENTION

In general, in one aspect, the invention features a system for determining whether wager data for players' wagers placed on a drawing game have been altered after winning game numbers are drawn. A host computer stores the wager data and generates a first hash value for the wager data at a time prior to drawing the winning game elements, the host computer being capable of generating a second hash value for the wager data at a time subsequent to drawing the winning game elements for comparison to the first hash value. A verification device receives the first hash value for the wager data prior to drawing the winning game elements and receives the winning game elements.

Implementations of the invention may also include one or more of the following features. The wager data may include players' game numbers and wager amounts.

The host computer may generate an intermediate hash value prior to generating the first hash value. The host computer may generate a transaction hash value for each of the players' wagers. The host computer may generate a first digital signature to uniquely identify the host computer, and append the first digital signature to the first hash value.

The verification device may generate a combination hash value for the winning game elements and the first hash value, and transmit the combination hash value and the winning game elements to the host computer. The host computer may generate a check hash value for the winning game numbers and the first hash value, and compare the check hash value to the combination hash value. The verification device may generate a second digital signature to uniquely identify the drawing device, and append the second digital signature to the combination hash value.

The host computer may include a memory for storing the wager data and the first hash value. The system may further include a gaming terminal for generating the wager data. The system may further include a drawing device for drawing the winning game elements. The system may also include an auditing device in communication with the host computer for generating a third hash value for the wager data and comparing the first hash value to the third hash value.

In general, in another aspect, the invention features a method of detecting whether any of a plurality of stored wager data for players' wagers placed on a drawing game has been altered after winning game elements are drawn. A first hash value for the plurality of stored wager data is generated before the winning game elements are drawn. A second hash value for the plurality of stored wager data is generated after the winning game elements are drawn. The first hash value is compared to the second hash value.

Implementations of the invention may also include one or more of the following features. The method may further include determining that at least a portion of the plurality of stored wager data has been altered based on a comparison of the first hash value and the second hash value. The method may also include transmitting the first hash value to an independent location before the winning game elements are drawn.

The first hash value and the second hash value may be generated using a one-way hashing function. The method may include generating an intermediate hash value based on a portion of the plurality of stored wager data prior to generating the first hash value. The method may also include generating a transaction hash value based on the stored wager data for each of the players' wagers.

In general, in another aspect, the invention features a method of securing a plurality of wager data for players' wagers placed on a drawing game. A wager data hash value for the plurality of wager data is generated at a first location. The wager data hash value is sent to a second location. The winning game elements are drawn. A combination hash value for the wager data hash value and the winning game elements is generated at the second location. The winning game elements and the combination hash value are transmitted to the first location.

Implementations of the invention may also include one or more of the following features. The method may include generating a check hash value for the wager data hash value and the winning game elements at the first location, and comparing the combination hash value to the check hash value. The method may also include appending a digital signature to the combination hash value at the second location.

An advantage of the present invention is that alterations of wager data after drawing the winning game numbers can be detected without having to make a copy of all of the wager data before the winning game numbers are drawn and without having to make a record-by-record comparison of the wager data before and after the drawing.

An additional advantage of the present invention is that alteration of wager data may be easily detected by a computer with limited processing and storage capacities.

A further advantage of the present invention is that wager data may be secured prior to drawing the winning game numbers for a game having any drawing frequency and using any drawing method, e.g., manual or electronic.

Other features and advantages of the invention will become apparent from the following detailed description, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagrammatic sketch of a gaming system according to the present invention.

FIGS. **2A** and **2B** are a flow chart showing the operation of the gaming system of FIG. **1**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention relates to the use of hash values and digital signatures to enhance the security of wager data for a drawing game. A unique hash value for the wager data is generated before the winning game numbers are selected. If the wager data is altered after the winning game numbers have been selected, a hash value subsequently generated for the altered wager data will not match the original hash value for the wager data.

A hash value is a fixed numerical value or string of digits generated from text, i.e., a string of text characters. The hash value is a numerical representation of the contents of the text, and is smaller than the text in that it may be stored in less memory space than the text itself. The hash value is preferably generated by a one-way hashing function, which is a formula or algorithm applied to the text for which it is extremely unlikely that the same hash value will result from applying the hashing function to a different text.

A digital signature is a digital code attached to an electronically transmitted message that uniquely identifies the sender of the message. A one-way hashing function may be used to create the digital signature.

FIG. **1** shows a gaming system **10** for determining whether wagers have been altered after winning game numbers have been drawn. FIGS. **2A** and **2B** are a flow chart showing a method **100** of operating gaming system **10** to determine whether wagers have been altered after winning game numbers have been drawn.

Gaming system **10** includes a gaming terminal **20**, a host computer **30**, and a verification device **40**. These components of gaming system **10** may communicate with each other over a network **35**. Network **35** is preferably a secure, private network. Network **35** may also be the Internet or any communications network such as a dial-up, hard-wired or wireless digital network. Any data, messages or files transmitted over network **35** may be encrypted for security.

A player places a wager for a drawing game at gaming terminal **20** (step **110**). For example, the player may tender a wager amount in the form of cash money to an operator of the gaming terminal in exchange for a gaming ticket printed by the gaming terminal including the player's game numbers and the wager amount. System **10** may also include a plurality of similar gaming terminals **22** . . . **24** connected over network **35**.

Gaming terminal **20** generates wager data including the player's game numbers and wager amount (step **120**). The player's game numbers may be selected by the player or chosen randomly, e.g., using a random number generator **26** to perform a "quick-pick" function. The wager data may also include other data pertaining to the player's wager, such as the amount wagered, the date of the wager, the game for which the wager was made, the location of gaming terminal **20**, the name of the player, non-wager transactions and wager pool totals.

Wager data generated by gaming terminal **20** is transmitted to host computer **30** over network **35** (step **130**). Host computer **30** includes a processor **32** and a memory **34** for processing and storing data transmitted to the host computer from gaming terminal **20**. Memory **34** further includes a journal file **36** for storing data pertaining to gaming transactions processed by the host computer.

At some point before winning game numbers are drawn for a drawing game, all wagering for the game is stopped (step **140**). In the meantime, host computer **30** accumulates all of the wager data for a particular game in journal file **36** (step **150**). Processor **32** applies a hashing function to generate a wager data hash value **H1** for at least the game numbers and wager amounts of all of the players' wagers for the game (step **160**). The hashing function is preferably a one-way hashing algorithm and can be, e.g., MD5, SHA, or any other strong cryptographic method. The wager data hash value **H1** is stored in memory **34** (step **170**).

If there is too much wager data to handle quickly or efficiently, or if too much time is required to generate the wager data hash value **H1**, then intermediate hash values **h1** . . . **h3** may be generated at predetermined intervals for portions of the wager data being accumulated for the game (step **152**). Each intermediate hash value **h1** . . . **h3** may be generated based on all of the new wager data pertaining to wagers made during a time interval as well as the intermediate hash values generated during previous intervals.

If sufficient calculating time is available, it may also be possible to generate a transaction hash value **T1** . . . **T2** for

each individual wager (step **154**). Thus, the transaction hash value is calculated from a subset of all of the wager data generated for the drawing game. The transaction hash values T1 . . . T2 may then be stored in journal file **36** along with the wager data, with intermediate hash values h1 . . . h2, or with wager data hash value H1. Storing transaction hash values T1 . . . T2 provides a simple way of determining which transactions may have been altered.

Host computer **30** may also create a digital signature S1 based on wager data hash value H1 to uniquely identify the host computer. The digital signature may be created using a cryptographic signature algorithm, e.g., DSS. Digital signature S1 is stored in memory **34** and appended to wager data hash value H1 (step **180**).

Verification device **40** is an independent location which receives the wager data hash value. Verification device is associated with one or more drawing devices **46**, **48**, which draw the winning game numbers. Verification device **40** may also include a processor **41** and a memory **42**.

Host computer **30** transmits wager data hash value H1 with appended digital signature S1 to verification device **40** prior to the drawing of the winning game numbers (step **190**). By checking digital signature S1, e.g., using public key cryptography, verification device **40** can verify that the wager data hash value was sent by the correct host computer.

After the wager data hash value has been received and digital signature S1 has been verified, winning game numbers N1 . . . N6 for the drawing game are selected by drawing device **46** and transmitted to the verification device (step **210**). Verification device **40** may store the winning game numbers in memory **42** and transmit the winning game numbers to host computer **30**, which stores the winning game numbers in the memory **34** (step **220**), and to a distribution medium **50** for transmitting the winning game numbers to the players of the game by, e.g., closed-circuit television, publicly-accessible television or printed publication (step **230**).

Verification device **40** also uses a hashing function to generate a combination hash value H2 based on both the wager data hash value H1 and the winning game numbers N1 . . . N6 (step **240**). Verification device **40** transmits combination hash value H2 to host computer **30** (step **260**). The verification device may also create a digital signature S2 based on combination hash value H2 and append digital signature S2 to the combination hash value so that host computer **30** can verify the authenticity of the verification device that transmitted the winning game numbers (step **250**).

After receiving the winning game numbers from verification device **40**, host computer **30** verifies that the winning game numbers were transmitted by the correct verification device. Host computer **30** then applies a hashing function to both wager data hash value H1 and winning game numbers N1 . . . N6 to generate a check hash value H3 (step **280**). The host computer authenticates the winning numbers N1 . . . N6 received from the verification device by comparing combination hash value H2 to check hash value H3 (step **290**). If these hash values are the same, then the winning game numbers N1 . . . N6 received by host computer **30** are deemed to be authentic.

To determine whether any wager data for the drawing game has been altered, the hash value for the wager data may be recalculated at any time for the wager data stored in journal file **36** (step **300**), and compared to the original wager data hash value H1 (step **310**). It would be nearly impossible to alter any of the wager data without affecting the recalculated hash value for the wager data. If the recalculated hash value for the wager data differs from the original wager data hash value H1, then the gaming authority may conclude that some of the wager data has been altered. The gaming authority may then search through the stored wager data to determine which portion of wager data was altered.

The data stored in memory **34** and the contents of journal file **36** may also be copied and transmitted to an independent auditing device **60**, e.g., by digital electronic transmission or by physical delivery of the data. Auditing device **60** uses wager data hash value H1, combination hash value H2, winning game numbers N1 . . . N6, the original wager data or transaction hashes T1 . . . T2, and digital signature S2 of verification device **40** to verify the following:

1. Only correct wagers were included in the drawing game, and none of the wager data was altered;
2. The verification device that transmitted the winning game numbers was the correct verification device; and
3. The winning game numbers transmitted by the verification device were the same as those recorded in the journal file.

Either host computer **30** or auditing device **60** may recalculate the hash value for the wager data at any time to ensure that none of the wager data was altered and that no wagers were made after the original wager data hash value H1 was sent to verification device **40**.

Other embodiments are within the scope of the following claims.

What is claimed is:

1. A system for determining whether wager data for players' wagers placed on a drawing game have been altered after winning game elements are drawn, comprising:

a host computer for storing the wager data and generating a first hash value for the wager data at a time prior to drawing the winning game elements, the host computer being capable of generating a second hash value for the wager data at a time subsequent to drawing the winning game elements for comparison to the first hash value; and

a verification device for receiving the first hash value for the wager data prior to drawing the winning game elements and for receiving the winning game elements;

wherein the verification device generates a combination hash value for the winning game elements and the first hash value, and transmits the combination hash value and the winning game elements to the host computer.

2. The system according to claim **1** wherein the wager data includes players' game numbers and wager amounts.

3. The system according to claim **1** wherein the host computer generates an intermediate hash value prior to generating the first hash value.

4. The system according to claim **1** wherein the host computer generates a transaction hash value for each of the players' wagers.

5. The system according to claim **1** wherein the host computer generates a first digital signature to uniquely identify the host computer, and appends the first digital signature to the first hash value.

6. The system according to claim **5**, and further comprising a drawing device for drawing the winning game elements, wherein the verification device generates a second digital signature to uniquely identify the drawing device, and appends the second digital signature to the combination hash value.

7. The system according to claim **1** wherein the host computer generates a check hash value for the winning game

elements and the first hash value, and compares the check hash value to the combination hash value.

8. The system according to claim 1 wherein the host computer includes a memory for storing the wager data and the first hash value.

9. The system according to claim 1 further comprising

a gaming terminal for generating the wager data.

10. The system according to claim 1 further comprising

a drawing device for drawing the winning game elements.

11. The system according to claim 1 further comprising

an auditing device in communication with the host computer for generating a third hash value for the wager data and comparing the first hash value to the third hash value.

12. A method of detecting whether any of a plurality of stored wager data for players' wagers placed on a drawing game has been altered after winning game elements are drawn, comprising:

generating a first hash value for the plurality of stored wager data before the winning game elements are drawn;

generating a second hash value for the plurality of stored wager data after the winning game elements are drawn;

comparing the first hash value to the second hash value; and

generating a combination hash value for the winning game elements and the first hash value.

13. The method of claim 12 further comprising

determining that at least a portion of the plurality of stored wager data has been altered based on a comparison of the first hash value and the second hash value.

14. The method of claim 12 further comprising

transmitting the first hash value to an independent location before the winning game elements are drawn.

15. The method of claim 12 wherein the first hash value and the second hash value are generated using a one-way hashing function.

16. The method of claim 12 further comprising

generating an intermediate hash value based on a portion of the plurality of stored wager data prior to generating the first hash value.

17. The method of claim 12 further comprising

generating a transaction hash value based on the stored wager data for each of the players' wagers.

18. The method of claim 12 further comprising

generating a check hash value for the winning game elements and the first hash value; and

comparing the combination hash value to the check hash value.

19. A method of securing a plurality of wager data for players' wagers placed on a drawing game, comprising:

generating a wager data hash value for the plurality of wager data at a first location;

sending the wager data hash value to a second location;

drawing the winning game elements;

generating a combination hash value for the wager data hash value and the winning game elements at the second location; and

transmitting the winning game elements and the combination hash value to the first location.

20. The method of claim 19 further comprising

generating a check hash value for the wager data hash value and the winning game elements at the first location; and

comparing the combination hash value to the check hash value.

21. The method of claim 19 further comprising

appending a digital signature to the combination hash value at the second location.

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